CHAPTER VII

CONCLUSIONS, PROBLEMS AND SUGGESTIONS
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7.1 Conclusions
7.2 Problems of the Study Region
7.3 Suggestions
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Water is an essential natural resource. It is becoming more and more scarce and valuable resource as population and water consumption rise. Water resource management is poor in India. Especially in region like Marathwada, water resource management is very less. The paucity of water is a well-known fact in many part of the Marathwada region. Today water resource management is very important for sustainable development.

In previous chapter various aspects of selected villages from the study area have been analyzed. Investigations carried out in the previous chapter have thrown light on impact of watershed development on agriculture in Nanded district.

The main purpose of this chapter is to sum up the main inference the study presented in the previous chapters to get comprehensive view on the basis of these conclusions. Impact of watershed and development on agriculture problems are also discussed in this chapter. Some remedies or suggestions have also been suggested to solve the problems relating to this study in this chapter.

7.1 Conclusions:

The entire study region is located on the Eastern part of Marathawad. It lies in Godavari River basin. Most of the region is drained by the Godavari, Penganga, Manyad, Lendi, Manjara, Asna, Sita and its tributaries. The height of the low land area of the Godavari, Manjara and Manyad River basin is
ranging from 150 to 300 meter above mean sea level where slope of the land is 0.4°. Rainfall of the region is uncertain and erratic in nature. Regur is the predominant soil type in the region which is categorized in to three types on the basis of its texture that in coarse shallow soil, medium deep black soil, deep black soil. These soil types are suitable for agricultural practices.

Environment of the region is relatively favorable for the watershed development and agriculture development. Hence development in several socio-economic sectors witnessed.

The significant part of the conclusion drawn on the basis of the study accomplished through preceding chapters is given below.

The use of the rainfall for agriculture is limited due to its concentration in to a few months. The rainfall may be sufficient if it is well distributed and is received at the time when required. The concentration of the rainfall in certain period reduces its usefulness.

The region received 90 % of rainfall during the period of South-West Manson. Remaining 10 % rainfall is received in the rest of period. Mudkhed received highest rainfall followed by Mahoor, Kinwat.

A the beginning of March, the rapid rise in temperature starts May is the hottest month with mean daily maximum temperature increasing to 41°C. With the region, by the second week of June the temperature falls. The weather is pleasant thought-out the South-West Monsoon. In first week of October the Monsoon withdraws and the say temperature increases. Temperature increases in October up to 33°C and then the temperature starts to decrease.
The soil farming factors, topography shows a dominating influence on soil variations in the district. The soil of the district mostly derived from the Deccan traps and spurs from then uplands which are all trap formation, reduce the cultivable area considerably.

Forest in Nanded district is dry mixed deciduous type with teak at the most valuable species. Besides teak, the other important species found in the forest are bamboo and grass. The other important species found in the forest are Ain, Dhawada, and Kalam. Tembhurni leaves, which are used for Bidi Industry, are miner product of the forest. The important species of grass are poonya, Kusal and Sheda.

The density of population in total Nanded district as per 2001 census is 273 persons per sq. kilometres and as per 2011 census is 319 people per sq. kms. The distribution of tahsils by highest and lowest indicates that there are as per 2001 census highest (408) density tahsil is Nanded and lowest (118) density tahsil is Kinwat. As per 2011 census highest (475) density tahsil is Nanded and lowest (141) density tahsil is Kinwat.

The districts literacy rate is 67.8 percent asper 2001 census and males and females literacy rate is 80.4 percent and 54.3 percent respectively and as per 2011 census district literacy rate is 75.5 percent and males and females literacy rate is 84.3 percent and 66.1 percent respectively.

As per census 2001 the tahsil wise break-up of total literate persons shows that Nanded tahsil has highest literate persons (391868 persons) and lowest literates persons tahsil is Umri (43857 persons).
As per census 2011 the tahsil wise break-up of the total literate persons shows that Mukhed tahsil has highest literates persons (165171 persons) and lowest literates persons tahsil is Mahur (66326 persons).

The existing pattern of land use is shown in map. There is change in physiographic, soil types, rainfall and geology all these factors played important role in determining the agricultural practices. Data for 1994-95 and 2009-10 was obtained tahsil wise.

Area about 92050 hectares or 8.91 % of the total geographical area of Nanded district was under forest during 1994-95. Forest area decreased from 92050 hectares to 82402 hectares i.e. by – 0.94 % during the period of investigation.

Volume of change in land not available for cultivation is shown in the map 3.3 B pattern is observable in change. Over all changes are significant. Below 3 % negative change in this category is observed in Mukhed, Degloor, tahsils, whereas below 3 % positive change in area not available for cultivation was observed in Nanded, Biloli tahsils during the period of investigation.

During 1994-95 about 75380 hectare of land was under fallow land category. It decreased up to 54303 hectares in 2009-10. Out of total geographical area below 5 % area under this category was registered in Biloli tahsil and 5 % to 7 % area in this category was found in Kinwat, Hadgaon, Kandhar, Mukhed tahsil and above 7 % geographical area in this category bwas Nanded, Bhokar, Degloor tahsil during 1994-95.
Out of total geographical area less than 5% area under this category was registered in Hadgaon, Himayatnagar, Nanded, Ardhapur, Mudkhed, Bhokar, Biloli, Dharmabad, Degloor, tahsil and 5% to 7% area in this category was found in Kinwat, Mahur, Umri, Naigaon, Kandhar, Loha, Mukhed tahsil during 2009-10.

Except Kinwat, Hadgaon, Nanded, Bhokar, Biloli, Kandhar, tahsil remaining tahsil showed increase in fallow land in the study region during the period of investigation in 1994-95 and 2009-10. Above 15% negative change in this land use category took place in Degloor tahsil, while 5% to 10% positive change in this group of fallow land is experienced in Kinwat tahsil is from 1994-95 and 2009-10. Nanded district had 7.29% fallow land in 1994-95 which is decreased by -2.04 and reached up to 5.25% in 2009-10.

Cultivated areas with 700808 hectares or 70.73% of its total geographical area devoted to crops during 1994-95 and 836591 or 80.97% area under this land use category to the total geographical area of the district was there during the period of investigation. This indicates that overall increase net sown area. Below 20% positive change in net sown area was recorded in Mukhed tahsil and 20% to 40% positive change in net sown area was recorded in Degloor tahsil. About above 50% positive change in net sown area was recorded in Kinwat, Hadgaon, Nanded, Bhokar, Biloli, Kandhar tahsils during the periods under study. Some fallow and other cultivable waste land was transferred to net sown area during the period of investigation.
Out of the total geographical area below 75% area under net has sown area in Kiwat, Hadgaon, Bhokar, Kandhar, Degloor tahsil, whereas 75% to 85% area under this land use category was registered in Mukhed tahsil. Over 85% area was recorded in this group in Nanded tahsil during 1994-95. The extent of cultivated area in the study region has changed over the past fifteen years, about 730808 hectares area 836591 hectares in 2009-10.

Per capita net sown area was 0.32 hectare in 1994-95 in the region, which decreased to 0.30 hectare in 2009-2010. Per capita net sown area varies from tahsil to tahsil in the study region. During period 1994-95, Hadgaon, Kinwat and Bhokar tahsils are leading in per capita net sown area in i.e. 0.43, 0.42 hectare the study region. Highest per capita net sown area was in Hadgaon tahil i.e. 0.43 hectare in the same years; whereas low per capita net sown area was in Nanded tahsil i.e. 0.13 hectare. During period 2009-10, Kinwat, Himayathnagar, Bhokar tahisils are leading in per capita net sown area in i.e. 0.46, 0.39, 0.38 hectare the study region. It is observed that per capita net sown area is decreasing in the region from 1994-1995 to 2009-10. This is due to increase in population.

Decreasing per capita net sown area in the study region is serious problem. The policy implication of decreasing per capita net sown area is that the pressure of population on land is increasing and way and means have to be found out to increase productivity of available land for meeting the growing food needs of the region. It is possible through adopting new farm technology in the entire study region.
Area of low land efficiency was recorded in Kinwat, Bhokar and Biloli tahsils during 1994-95. Rugged topography un cultivable waste land, lack of irrigation facilities, poor soil conditions, low use of chemical fertilizers, pesticides and other natural as well as socio-economical factors are responsible for low efficiency. During 2009-10 low land efficiency was recorded in Biloli tahsils respectively.

Area of medium land use efficiency was recorded in Degloor, Kandher, and Mukhed, Hadgaon tahsils during 1994-95. About – 5.84 % to – 0.09 % negative change in land use efficiency was registered in Degloor and Kandhar tahsils. About 0.98 % to 9.27 % positive change in land use efficiency was registered in Hadgaon, Mukhed tahsils. Mukhed tahsil’s agricultural research centers give guidelines to the farmers to increase land use efficiency.

High land use efficiency was observed in Nanded tahsil in (1994-95) period and Nanded, Ardhapur, Dharmabad, Loha, Mukhed tahsils (2009-10) during the period of investigation. The Nanded tahsil positive change in land use efficiency is seen during 1994-95 to 2009-10.

In Maharashtra state, of the five River basin systems, only 55 % of the dependable yield is available in the four River basins (Krishna, Godavari, Tapi and Narmada) east of the Western Ghats. These four River basins comprise 92 % of the cultivable land and more than 60 % of the population in rural areas. The Maharashtra state annual availability of water resources consists of 164 Km3 of surface water and 20.5 Km3. 58 % of average annual availability is found in major river basins (Krishna, Godavari, Tapi and Narmada). It has been
estimated that the annual replaceable ground water resource in the state of Maharashtra is 3.5792 million hectare meters and net annual ground water availability is 3.3913 million hectare meters.

The irrigation sector in Maharashtra one of the largest in country, both in terms of the number of large dams and the live storage capacity never the less, the irrigation sector of Maharashtra has been facing multifarious problems. While the water availability for the future use of irrigation has been reducing at a fast rate, the demand for water for irrigation purposes has been alarmingly increasing due to agriculture expansion and intensification.

The major, medium, minor projects and wells irrigation its modes of irrigation are used for irrigation the agricultural land in the study region. Major irrigation project can change the socio-economic structure of the region. Nanded district has got advantage of four major projects. There are ten medium projects in the study area. Medium projects have created 22606 hectares irrigation potential in Nanded district out of ten medium projects. three medium projects constructed in Kinwat taluka, two medium projects in Kandhar taluka and remaining five medium irrigation projects are constructed at Mukhed, Bhokar, Degloor, Loha, Dharmabad taluka of the region. All provide seasonal water to the limited area.

The minor schemes have crated about 18823 hectares irrigational potential in the study region. Highest irrigation potentials are created in Mukhed taluka 3526 hectares, while the lowest potentials are 187 hectares in Ardhapur taluka. Benefited area differs from taluka to taluka.
As the cost of construction of well is low, they are well suited to the poor and marginal farmers. There is great demand for irrigation wells due to the paucity of other irrigation facilities. Nanded district has given more priority for the construction of new wells through five-year plans in the study region. Various financial agencies are providing long-term loan for the construction of new well and short-term loan for the repair of the old wells.

The wells irrigation pattern in Nanded district in year 1984-1985 was 11565 hectares, increased in year 2009-2010 i.e. 46451 hectares. Wells irrigation is dominate in Nanded taluka in the year 1984-1985 (36.51%), but it is less increase in year 2009-2010 (12.96%) as compare to other all taluka.

The surface water irrigation is very useful and traditional practice in Nanded district because of the Godavari River. The surface water irrigation pattern in Nanded district in year 1984-1985 was 22545 hectares. It is drastically decreased in year 2009-2010 i.e. 18441 hectares.

The other source of irrigation pattern in year 1984-1985 was 26235 hectares. It is decreased in year 2009-2010 i.e. 22708 hectares. Other source of irrigation is dominant in Kandhar taluka in the year 1984-1985 (0.78%). But it is drastically increased in year 2009-2010 (12.49%) as compare to other taluka. Kandhar taluka has hectares of land under other source of irrigation in the year 1984-1985. Mukhed taluka has under other source of irrigation in the year 2009-2010.
It reasons for decreased is rainfall in the study area is critical and irregular, uneven distribution of rain in the study area. Due to the uneven and irregular rainfall, water table in the study area.

The total cropped area or gross sown as percentage to net area sown gives a measure of landuse efficiency, which really means the intensity of cropping. The effect of irrigation facilities, cultivators per 100 hectares of the cultivated area, the impact of nature of soil, meager rainfall and size of holding were the most direct explanations of the variation in the area distribution of intensity. The intensity of cropping of the study region was 107.55 during 1994-95 and 116.34 per cent during 2009-10. The much low cropping intensity is alarming situation to planners, economists and geographers. Out of sixteen tahsils one tahsil namely Dharmabad is registered very low cropping intensity ranging from 50-10 per cent only (2009-10). Mukhed tahsil registered slightly improved position i.e. it’s cropping intensity is 122.53 per cent only. In the study region only four tahsil namely Mudked, Himaytnagar, Kinwat, Naigaon, shows abetter position and comes under the range of 115.1 to 120 per cent cropping intensity during 2009-10. During the period under investigation all tahsils have recorded increasing trend in cropping intensity. Nanded and Mukhed tahsil have noted significant change in cropping intensity.

Productivity is the measure of landuse efficiency. Landuse efficiency is largely related to the choice of inputs. The inputs may tend to increase or decrease the efficiency of land. To improve the productivity, there is a need of inputs like irrigation, fertilizers, pesticides, HYV seeds etc.
The improved seeds programme in the district has changed the traditional cropping pattern to certain extent and marked the beginning of agricultural development. In Nanded district 115.53 quintal seeds were distributed during 2010. Farmers get relatively quick returns on fertilizers. Consumption of fertilizers is unevenly distributed. Higher use of fertilizers was noticed in irrigated areas i.e. Nanded tahsil, while lower use in Degloor tahsil of the region. Biloli tahsil have a better position in respect of use of chemical pesticides during the 1994-95. While Hadgaon, Bhokar have a poor position in its use during the period under investigation. The agricultural production must be increased by using the new agricultural implements, high yielding varities of seeds (HYV), chemical fertilizers, proper irrigation facilities, insecticides and pesticides.

Agricultural density is Nanded in1981 tahsil (88 persons per Km²) followed by Hadgaon and Kinwat tahsil. Where as low agricultural density was observed in Bhokar tahsil 63 persons per Km². Agricultural density for the district was 75 persons per Km² in the same year. In 2011 year agricultural density for the region increased to 104 persons per Km². It is recorded higher than the average for the region in Mahur (182), Naigaon (140), Nanded (128), Ardhapur (121), tahsils and lowers in Kinwat (69), Bhokar (77), and Dharmabad (78) tahsils in the same year.

The agricultural density has shown an increasing trend from 1991-2001 in almost all tahsils of the region. Above 100 persons per Km² agricultural density were observed in Nanded (124), Kandhar (108), and Mukhed (106)
tahsils in 1991 year and above 100 persons per Km$^2$ agricultural density were observed in 2001 year are almost of tahsils. Below 100 persons per Km$^2$ agricultural density was found were is almost of tahsils in 1991 year and below 100 persons per Km$^2$ agricultural density was found were in Kinwat (81), Bhokar (97) during 2001 year. Agricultural density increased in every tahsil during the period of twenty years. It means that majority population depends upon agriculture. Agricultural density does not take into account potential productivity of soil. Therefore, it cannot be used as reliable measure for scientific planning of land use.

During 1994-95 low level of rice productivity is noticed in Mukhed, Degloor tahsils while high level of rice productivity is found in Bhokar, Nanded and Hadgaon tahsils this part of the region receives relatively higher amount of rainfall. During 2009-10 low of rice productivity is noticed in Himayatnagar tahsil and high level of rice productivity is found in Kinwat, Hadgaon and Umri tahsil. Only Nanded tahsil have shown the decrease in productivity level of rice during the period of investigation. This was due to increasing importance of other crops.

Tahsil like Nanded, Biloli, Kandhar and Degloor have registered high level of Jowar productivity during 1994-95 and low level of jowar productivity is found in Mukhed, Hadgaon and very low level of jowar productivity is found in Kinwat tahsil. The very low level of jowar productivity and except Ardhaphur, Nanded, Mudkhed, Bhokar, Umri, Dharmabad, Loha, Kandhar, Degloor and Himayatnagar tahsil the high level of jowar productivity during
2009-10 Mahur, Kinwat and Hadgaon tahsil. Mukhed tahsil noted moderate level of jowar productivity.

During 1994-95 Nanded, Bhokar, Biloli and Kandhar tahsil have high level of sugarcane productivity and low level of productivity is recorded in Hadgaon tahsil and very low level of productivity is recorded in Degloor tahsil. Moderate productivity of sugarcane was found in Kinwat and Mukhed tahsil of the region. During 2009-10 Mahur, Hadgaon, Nanded, Mudkhed, Umri, Biloli and Dharmabad tahsil have high level of sugarcane productivity and low level of productivity is Kinwat, Ardhaphur, Kandhar, tahsil. Very low level productivity is found in Mukhed, Degloor, Loha, Bhokar and Himayatnagar tahsil and moderate productivity of sugarcane was found in Naigaon tahsil of the region.

Nanded, Kandhar, Degloor tahsils recorded high level of cotton productivity during 1994-95. Hadgaon tahsil have recorded moderate cotton productivity and low level of cotton productivity was registered in Biloli, Kinwat and Mukhed tahsil. During 2009-10 Mahur, Kinwat, Himayatnagar, Biloli and Dharmabad tahsil have high level of cotton productivity and moderate productivity of cotton was found in Naigaon and Loha tahsil of the region. Low level productivity of cotton registered in Umri tahsil during the period under investigation (Map. Kinwat tahsil registered upward shift from low to high and Hadgaon tahsil has shown moderate to low change during the period under investigation.)
Agricultural development of the overall the tahsils in 90 percentage above of Nanded, Hadgaon, Biloli, Degloor, in (1994-95) and Dharmabad, Degloor, Kandhar, Biloli, Umri, Mahur, Nanded, Himaytnagar, in (2009-10) record high level of agricultural development, which obviously enjoy the more advantageous environmental conditions in the district. The soil in this part of the region is medium to deep black and the rainfall is also fairly adequate for crops. Irrigation facilities are also more, use of agricultural inputs like chemical fertilizers, pesticides and high yielding verities of seeds is also much more in these tahsils.

The Medium development of agricultural is noticed in Kandhar in (1994-95) and Loha, Mukhed, Bhokar, Kinwat in (2009-10) tahsils during the period under investigation. Due to medium soil, inadequate rainfall and minimum use of agricultural inputs medium agricultural development in above tahsils have recorded.

Kinwat, Mahur, Mukhed, tahsils of Nanded district significantly noted low level of agricultural development during the period 1994-95 under investigation. Hadgaon, Mudkhed, tahsils of Nanded district significantly noted low level of agricultural development during the period 2009-10 under investigation. This is because of hilly and forested area, poor soil, less use of modern agricultural inputs.

The overall agricultural development in Nanded district revels that farmers get smaller returns from farm production in most of the tahsils in hilly
area and unirrigated areas where higher priority need to be given in agricultural planning of the region.

Some issues related to migration and labour availability in the context of watershed development are discussed in the previous chapter on equity, since they are crucial to the pattern of income generation among regions and sections. It is assumed that watershed development helps to decrease the extent of migration. Changes in the pattern of migration are generally taken as indicators of changes in employment opportunities, agricultural productivity and overall quality of life within the watershed villages.

The review of available literature and my field visits and interaction show that watershed development does have the potential to bring down distressed migration temporarily, especially in the initial phase of the programme when the emphasis is on physical works. However, in the post-project phase, one does not find a uniform trend. In fact, there are some instances where availability of work, especially seasonal agricultural work, has been reduced because of watershed development.

It shows that with the exception of integrated watershed management programme project villages, seasonal migration rose in every project category. The integrated watershed management programme villages had a net reduction in overall migration and the possible reasons for this may be improvements in infrastructure and access to services. However, the average figures mask the fact that more integrated watershed management programme villages experienced net out-migration than net in migration. The study also noted that
employment opportunities were reported to have risen in integrated watershed management programme project villages. Whereas in the Jal Sandharn and non-project villages more people indicated that employment had declined.

Before the projects 5 percent of the villagers in Dhanora (M) had deserted and gone to live in other villages, 50 percent had to work under National Resource Management (NRM) or as agricultural laboures in other villages. 10 per cent were fully employed in their own farms.

The integrated watershed management programme found that after five years in watershed management laboures in Rui village could find eight months of employment as opposed to three months earlier.

In Gandhinagar, Ghubadwadi, Sunegaon, Dhanora, Chitil, Guntur etc. villages there was an increase in employment on their own Farms, Fisheries cultivation, and sericulture agricultural based processing units, Dairy activities and Goatry, Tailoring and workers were brought in from outside.

Hiparga, Rui, Guntur, Digras, Kabegaon had seen massive unemployment with people migrating to Pune, Aurgnabad, Mumbai. After the project, marginal and small farmers could till their land throughout the year. Labour was imported by medium and large farmers from own villages for their own farm work. The sectoral share of labour income rose from a mere 12 per cent of the total village’s income to 25 per cent of it. Watershed development creates increased availability of wage labour during implementation and generates increased income from watershed programme (physical labor work wage) labour as compared to the agricultural wage system.
The water level has increased as a result of treatments in most projects. In Dhanora (M), Haldave, Pardi, Chitali villages the life of well is increased with water becoming available for 9 to 11 months in the year, which helped irrigation and increase in agricultural productivity by nearly 35 per cent.

On an average, the water table in the wells increased by 2.00 m. in the Rui village. The review shows that there has been an increase (of between two to three months) in the duration of flow of streams after watershed development programmes were implemented. In Haldave village, where the stream was reported flowing up to November prior to the watershed programme, now reports water in the stream till the month of January or later, even under normal rainfall conditions. The situation is resembling at village like Digras (Khu.), Guntur where stream flow has increased by a couple of months.

A note of caution must be sounded here however, while attributing the increased number of well to increased groundwater, because most often this information does not show the depth of the wells and comparative is by way of visual observation and local perception rather them systematic, scientific observation. However, many project villages have seriously undertaken monitoring of water level changes in wells.

One of the main objectives of integrated watershed management programme, especially in drought-prone regions, is to mitigate the distress with regard to water for drinking and domestic purposes (including water for cattle). Almost all watershed development guidelines factor in the extent of drinking
water shortage as a criterion for selection of a watershed development. In fact, an assured source of potable water should be the minimum benchmark to Graded. Bounding the success of a watershed programme, the increase in groundwater recharge would give a longer life to the water in wells and even the spring flow period would be extended. However, if the water withdrawal is unduly high for the Rabi crop then it is possible that the overdraft leaves no reserves left to last through summer, even for drinking, and hardships might increase.

The indicators also do not always document whether the villages had sufficient drinking water in the summer periods and drought years. The study of integrated watershed management programme projects villages noted an increase in the number of open dug wells for drinking and domestic purposes, and assured availability of drinking water due to seasonal wells turning perennial in Kabegaon, Hiparge, Rui, Guntur and Sunegaon etc. villages where though the volumetric water availability has increased for longer periods, water scarcity is still felt in late summer season. In the Dhanora (M), Rui villages too the number of trips from tankers fell to a minimum after the integrated watershed management programme.

The review shows clearly that watershed development has led to a significant increase in use of water for agricultural purposes. Unfortunately, in many places, this has been at the expense of drinking water. The review shows that many of the watershed villages experience drinking water shortage during the summer months—most villages experience a dire need for water tankers in
the summer months to fulfill their domestic water needs, especially during years when the rainfall is less than normal.

Increased mechanization also has an impact on draft animals, especially bullocks and male buffalos. It is noticed that in successful integrated watershed management programme villages the number of tractors as well as the use of tractors has increased.

Generally, in most watersheds villages reviewed there was an increase in milky animals as compared to the similar ruminants and there was an increase in the study area, found the presence of animals of improved breeds in larger numbers, in the integrated watershed management programme study area 24 is per-project 76 number of cross-breed animals and post-project is the 182 cross-breed animals improved. The highest numbers of such improved breeds were found in Dhanora (M) village and lowest in Guntur village is post-project in 5 cross-breed animals improved. The total milk production of the beneficiary was more than that of non-beneficiary farmers, it was lowest in Hiparge village (per-project 1773 liters and post-project 6747 liters per year respectively), and highest in Pardi village (per-project 217440 liters and post-project 478368 liters per year respectively).

In Pardi village the total number of milky animals increased from 641 in post-project. A milk collection center has been set up and a co-operative society of milk producers formed in village. A veterinary aid center and community cattle shed have also been established.
However the impact of many watershed developments villages on small ruminants in terms of the latter cannot be ignored because these are generally a livelihood support for the poor and marginal groups. It is also important to note that most often the increase in improved stall-fed cattle is favor of the better-off farmers who have greater access to water and fodder. Besides, livestock also contributes to ecological services such as fertilizing land. Hence it is important that livestock issues, especially of small ruminants/nondescript varities get specific attention in the planning and implementation of watershed project villages. It is also observed in studies that the workload of women, who spent more time collecting, cutting and carrying fodder.

The improved productivity of crops, especially rain-fed crops, and its contribution to the livelihoods of the people is taken as an important operational indicator of the performance of watershed development projects area.

As discussed earlier, soil and water conservation treatments coupled with specific productivity enhancement measures, have definitely increased productivity or at least helped to stabilize the kharif crop especially under normal rainfall condition.

The average yield kilogram per hectare rate of kharif crop soyaben per-project is 1460.00 kilogram and after the post-project average yield kilogram per hectare soyaben is 1620 kilogram increased in watershed development village of Dhonora (M). Kharif jowar is per-project average yield kilogram per hectare rate is 1335 kilogram and post-project rate is 1481 kilogram increased
percent in Dhanora (M). The pre-project cotton yield per hectre was 1100 Kg and post-project cotton yield is 1221 Kg in watershed development village in Dhanora (M). The yield rate in Dhanora (M) watershed development village for Mug (Green gram), Udid (Black gram), Wheat, Gram, Groundnut, Horticulture etc. has gone up 10 to 20 percent.

Among the field sites visited, Dhanora (M), Sunegaon, Pardi, Rui, Kabegaon, Gandhinagar, Hiparga, Haldave, Ghubadwadi, Digras (Khu.), Chitali and Guntur all reported an increase in kharif crops average yield.

The projected yield of wheat, a rabi crop under irrigation, was 1450 Kg which increased to 1897.5 Kg in post-project period in the village Dhanora.

The yield rate in integrated watershed management programme -24 study area for Rabi crops wheat and Gram the crops has gone up by 5 to 20 percent and the yield rate in IWMP-20 study area for Rabi crops Wheat and Gram the crops has gone up by 1 to 5 percent.

Crop productivity during kharif increased by average 5 to 10 percent and Rabi by 1 to 5 percent and in summer by 10 to 20 percent in the integrated watershed management programme villages because irrigation yields more benefits in the dry seasons.

Larger studies such as those indicate that there is great variation in productivity and the trend is not as uniform as it would seem from the case studies of the more promising ones. The aggregate information also may not reflect the regional/plot variations existing within a watershed due to various reason such as capability of land, inputs such as water, fertilizers etc. In a dry
land situation the variation in production, or for that matter the failure of crops, depends heavily on availability of some water for protective irrigation in critical and stress periods.

Cropping intensity generally increased in the watershed development in villages with the Rabi and summer crops being undertaken in watershed due to an improvement in irrigation of moisture levels. In Dhanore (M), Rui, Digras, Guntur and Chitali villages farmers started growing vegetables on small patches of land in Rabi season, with water fetched from wells.

In the all integrated watershed management programme villages, the total area was under only one crop before integrated watershed management programme and after the integrated watershed management programme area under was found under double crops.

Most of the watershed development villages showed a change in cropping pattern towards growing cash crops such as Groundnut, Vegetable, etc. overall there seems to have been a slight shift towards growing horticultural crops and plantations. Increased area under Groundnuts and vegetable is observed in IWMP-24 total villages the pre-project 18 hectares and increased after to 32.03 hectares post-project region and IWMP-20 total villages the pre-project 99.00 hectar and change in after 137.00 hectares post-project. Horticulture crops are increased in IWMP-24, and IWMP-20 total village’s changes 1 to 2 heceters.

In IWMP-24 and 20 totals villages, the use of new varieties of seeds became common and the use of chemical fertilizers increased, the
technological change in cultivation practices was also reflected in the increased cost of production due to use of improved inputs and machine power like electric motors, tractors etc. area under improved seed varieties increased and consumption of chemical fertilizers has increased from 32 to 80 tons per annum.

Though there has been an increasing awareness about sent sensitivity towards eco-friendly nutrient and pest management practices, many evaluation studies and our own field interaction show that use of chemical fertilizers and pesticides have been on the increases in areas where watershed development programmes (integrated watershed management programme) have been taken up especially where irrigation water is available.

The review shows that by and large, there has been an increase in the income levels of people through various means and options like increased availability of employment, development of allied sectors like dairy, fisheries, sericulture, agricultural based processing units and non land-based activities. Many villages like Hiparga, Chitile, Guntur, Digras (Khu.), Rui, Pardi produce marketable surplus (especially vegetables and other food and non-food crops). In most villages a spin-off effect of watershed development has been the growth of dairy activity as supplementary source of income.

The villages under study have shown that the increase in productivity has been achieved with higher costs. It is also reported that as a result of watershed development the composition of inputs changes, and there is more
dependence on modern inputs like improved/hybrid seeds, chemical fertilizers and pesticides, etc.

Among the important changes that were brought about in the watershed development villages was a reduction in alcoholism, an increase in literacy levels, an increase in nutrition levels of the families, an increase in capacities and relations with outside world. Many watershed developments of villages have also seen an improvement in the quality of life and basic infrastructure. The backward communities have a fair representation on the village’s watershed committees and participate actively in decision-making process. Once their financial condition improved, the people from these communities also began to get respect from the other villagers. Injustice by landlords and moneylenders also greatly reduced. The income earned from the work on watershed development sites helped them pay off their loans. As more children could go to school, literacy in the villages improved and today the literacy rate is about 60 to 70 per cent. Biogas plants were set up in some households in the case study villages and their fuel wood consumption declined. As drinking water become available within the villages, women stopped going for to fetch water and so could contribute more positively to the development of the villages. They setup a revolving credit and made loans available to the needy at the low interest rate of two percent a month.

In integrated watershed management programme villages there were also other positive impacts on social aspect such as education, housing, health care etc.
The study noted that there was an increase in the workload of women than earlier. Earlier many farmers used to cultivate only single crops and women had to do double duty only for one season. After the cultivation of two or three crops, their work increased considerably. Also, many cash crops, especially vegetables, need intensive supervision.

Across study area watershed development projects villages however, the participation of women was found to be of a token nature or marginal. In most case study villages, women are organized in to savings and credit groups.

7.2 Problems of the Study Region:

1. In-adequate Irrigation Facilities

The concentration of rainfall in certain period reduces its usefulness. The region receives maximum rainfall from June to September. Agriculture has held a dominant position in the region’s economy. Partial failure or even delayed onset and early withdrawal of monsoon can cause extensive damage of crops. One of the basic causes for the weakness of region agriculture has been that most of the farmers throughout the study region have to depend upon rainfall and very few of them can avail the facilities of artificial irrigation.

2. Uncertainty of Monsoon Rainfall

About 88 per cent of the total annual rainfall is received during the southwest monsoon. Average annual rainfall for the district is 897 millimeter, which is not evenly distributed. In general the amount of rainfall increases from south to north, Very important aspect of rainfall in the study region is its
variability. There is no guarantee of crops due to high rainfall variability in the study region.

3. **Problem of Low Productivity**

In general agricultural productivity per hectare in the study region is low. It is low because of traditional agricultural practices, lack of irrigation facilities, less use of chemical fertilizers and HYV seeds, pressure of population, lack of motivation, poor resource base, lack of training facilities and inadequate knowledge. It is ‘a gamble in monsoon’. Agricultural production is highly dependent on rainfall.

4. **Less Use of HYV Seeds**

Agriculture in the study region moreover, suffers from the application of inadequate and bad seeds. Sometimes the farmers have to open their seed-sector for consumption and for sowing purpose borrow it from the local grain merchants, which is bad and unhealthy. Therefore, the yield of agricultural crops is very low.

5. **Low Price of Agricultural Commodities**

Nearly 85 per cent farmer’s interviewed of the case study villages told that they are getting fewer prices to their agricultural commodities. Most of the small farmers sell their goods in the weekly markets. The farmers of the study region do not get proper price during the period of harvesting. The Government has fixed the prices of cotton and sugarcane crops. The farmers get their prices of cotton in two or three installments. That amount of cotton is not received at
proper time; hence, the farmers have to face economic problems. Sugar factories of the study region also exploit the farmer.

6. Lack of Proper Marketing System

Marketing facilities are very poor in the region. There are forty-one regulated market centers and fifty-two sub marketing centers in the study region. They have very poor facilities of market. Most of the farmers, sell their agricultural commodities in the villages due to lack of communication and transportation facilities with nearest market.

7. Problem of Sub-Division and Fragmentation of Holding

In study region the average land holdings are small but also they are fragmented and are found not in one block but also in tiny plots scattered all over the villages. Each holding consists of many small pieces, which are found in different parts of villages. Growing population, decline of joint family system, rural indebtedness and indigenous moneylenders are the causes of small agricultural holdings in the study region.

8. Problem of Plant Protection

No systematic quantitative studies have been conducted in the study region so far to determine the losses caused by insect pests and plant diseases. The quantity of pesticides used in the study region is not sufficient for the plant protection from the various diseases. Most of the farmers are economically poor and they are unable to use huge amount of pesticides for the plants to protect them from diseases.
9. **Poor Economic Condition of Agricultural Labour**

The income of agricultural labours is very low. A large part of their income is derived from wages. Mostly 85 per cent agricultural labours are having poor economic status. The daily wage for a male agricultural labour is Rs. 150 to 200 and for female workers the wage rate is Rs. 50 to 100/- per day. Their wages are much lower than of industrial and others labour. Agricultural workers are still illiterate and ignorant in all tahsils in the study region. They live scattered in the villages. Hence, they cannot easily be organized in unions. Another thing is that those agricultural workers do not have continuous work on farm. The food taken by labourers is far from being nutritious. Income is low and expenditures are increasing amongst the agricultural labour families in the study region.

10. **Disguised Unemployment**

Generally speaking, agriculture is a chronically depressed occupation. There are too many people who depend on agriculture. Above 78 per cent population is engaged in agricultural activities. Agricultural density has increased in every tahsil during the period under study. It means majority population depends on agriculture and agriculture income is not assured due to erratic nature of monsoon rainfall.

**7.3 Suggestions**

Some viable suggestion have given below

1. To solve the problem of untimely and unequal distribution of rainfall micro level planning should be done in all tahsils for crop system on the
basis of ecological consideration. It is necessary to identify the best cropping system for any local area under the prevailing rainfall and climatic condition. The farmers should be given training about the drip irrigation. Each and every drop of rainwater should be percolated in the soil and extra running water should be collected in percolated tank. Percolation tanks, kolhapure type bandhares should be constructed in all villages.

2. To solve the problems of inadequate irrigation, it is necessary to see that regions water resources are put to almost efficient use effective demonstration must be given to convince the cultivators for the proper use of water for different areas and crops. To solve the problem of large diversity of crops, it is necessary to increase the rate of irrigation. Government should take responsibility of the farmers, crops like sugarcane and cotton.

3. The pressure on land may be reduced by setting up industries in the rural areas to provide employment to the landless labours.

4. To solve the problem of low productivity provision of irrigation, high yielding variety seeds, manures, fertilizers and farm implements at concessional rate, should be provided to farmers in all tahsils.

5. In order to improve the economic conditions of agricultural labours, the fixation of working hours should apply to all agricultural labours and works and increase the wages of agricultural workers. The landless workers should be provided agricultural land. Government can plan
a project in the rural areas carefully, so that the workers who are unemployed during off season may be gainfully employed. Such project includes the construction of roads, the digging and deepening of tanks and canals etc.

6. In the coming decade, Nanded district water demand will increase and at that time water scarcity will become serious issue. So to overcome this situation, preventive measure and action should be taken from today.

7. Economy of this region is dependent on agriculture. About 75 per cent of working population is engaged in primary activities, especially in agriculture. To produce maximum income from agriculture we need to supply required water but development of water resource as per agriculture is not uniform in all parts of the area and pressure of population is increasing on agricultural land. Imbalance in the development of agriculture leads to imbalance in the socio-economic development in the region. Therefore to minimize the disparity in the development of the agriculture there is need to uniform development of water resource project and watershed development programme. If some where project cannot be developed than that area water should supply from other high water sources area.

8. Make aware people about the necessity of water and its conservation. Also involve them in all activates of watershed management programme and water resources management.
9. In whole Nanded district tahsil area installation of rainwater harvesting system should be compulsory. Education, institutes, social community, NGO and government should apply rainwater harvesting system where it is applicable.

10. Water should be saved using different techniques such as drip, sprinkler and other advance irrigation methods instead of flow method, so some amount of water can be saved.

11. Less water requiring crop and crop patterns should be selected in ware shortage region.

12. Don’t use more water than necessary.

Based on the analyses, discussions and observation on the impact of the watershed development programme in the sample watershed areas, the following suggestion could improve in the working of the programme for long-term sustainability:

a) The animal programme has to be intensified in the watershed areas.

b) The forest department should be involved in the pasture development, forestation activities.

c) Need for more thrust on community participation in the watershed programme.

d) Identifying the need based rural non-farm activities for equitability and sustainability of the watershed programmes.

e) The watershed associations could be made a subcommittee of the Gram panchayats, so that utility of the development programmes could be
optimized. Also, all the institution in the village could be integrated for systematic implementation of development programmes.

f) The funds generated under the watershed development fund has to be utilized only for operation and maintenance of the assets created under the project. It is seen that this is not being utilized due to the local political situations prevailing. There is need of good coordination between the NGOs, Government Officers and implementing agencies.